Khalda Petroleum Company		Petrofac	
Project: Salam Gas Trains 3 & 4 (SGT3 & 4) Project			
Location: Egypt			
Client's Project No.:	1820	Petrofac Project No.:	JI-187

HAZID STUDY REPORT

Petrofac International Ltd	
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Revision History

Rev	Date	Description of Change
A	07January 2007	Issued for IDC
B	18 January 2007	Issued for Client's Review

Approval Authority: (Project Manager / Project Engineering Manager)

Owner	Developer	Reviewer	Approver
GSN		AMK/RK	BK/GSN

Summary / Holds

None

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ABBREVIATIONS

KPC	Khalda Petroleum Company
PIL	Petrofac International Limited
EPC	Engineering, procurement and construction
ESD	Emergency shutdown
ESDV	Emergency shutdown valve
HAZID	Hazard Identification study
HAZOP	Hazard and Operability Study
SIL	Safety Integrity Level
HVAC	Heating ventilation and air conditioning
PTW	Permit to Work
HAZARD	An inherent physical and/ or chemical characteristic that has the potential for causing harm to people, property and the environment.
RISK	Is any threat to the goals of achieving safety to public, environment and property This is calculated by combining the likelihood of a hazardous event, with its consequences,
OSD	Operational Shutdown
DCS	Distributed Control System
PPE	Personal Protective Equipment
HSE	Health, Safety and Environment
NDT	Non Destructive Test
HSE	Health, Safety and Environment

1.0 INTRODUCTION

A detailed safety & environment HAZID workshop for the Salam Gas Trains 3&4 Project (SGT 3&4) was conducted on 26th December 2006 and on 3rd January 2007 at Petrofac International Limited (PIL) Sharjah office.

This document reports the findings of the Hazard Identification (HAZID) Study carried out for the Salam Gas Trains 3&4 (SGT 3&4) Project of Khalda Petroleum Company (KPC). KPC has awarded the EPC contract for this Project to Petrofac International Limited (PIL).

1.1 Background

KPC intends to install a third and fourth gas processing trains (SGT 3&4) to its existing (SGT1&2) gas facilities in Salam area to process the gas produced in its new discoveries. Similar to SGT1&2; SGT 3&4 will be a dew point control train with nominal produced sales gas capacity of 100 MMSCFD. SGT 3&4 will include the same basic systems as those of SGT1&2.

The SGT 3&4 plant will be built in the Salam area to the north of the existing SGT1&2. The feed gas to SGT 3&4 will be directed to the plant from the new discoveries through a new pipeline, to be designed and installed by others, that will end at the plant battery limits by the fence line. The plant will have the capabilities to compress the sales gas to the existing northern pipeline system, presently used to export the sales gas produced in SGT1&2.

The produced condensate will be stored in new storage tanks to be installed south of the existing condensate storage tanks of SGT1&2.

The project approach is based on installing each of SGT 3&4, in principle, as a stand alone train that is envisioned to be a duplicate of TGT1(Tarek gas train, approx. 60 km away from SGT1&2) to the maximum extent possible. However limited changes and modifications, from TGT1 original design are anticipated due to plant feed conditions and composition.

1.2 Objectives

The objectives of the HAZID study are to:

- Check that all major hazards (Health, Safety, Environmental) have been identified;
- Identify existing safeguards that inhibit the realization of the hazard and mitigate against the consequences of the hazard.
- Recommend potential risk reduction measures.

1.3 Scope

The scope of the study is to identify and assess the hazards associated with the new facilities as per the following drawings.

- 1820-SA3-00-EPI-PLP-001 Rev. A Salam Gas trains Overall Plot plan
- Heat and mass balance, doc. No. 1820-SA3-00-EPR-HNM-001
- Process Flow Diagrams Dwg. No. 1820-SA3-00-EPR-PFD-001 (6 Sheets)

The study was focused to consider the operational and relevant construction hazards. However, team has recognized that a detailed HAZCON study will be performed by the construction team to review the construction related hazards in detail.

2.0 HAZID ATTENDEES

List of participants in the HAZID workshop is as below:

Table 2.1 HAZID Attendees

Name	Discipline	Company
Raj Kochar	HAZID Chairman	Petrofac, Sharjah
Wael A.EL-Hamid	Scribe	Petrofac, Sharjah
A.Mujeeb Khan	Technical Safety Specialist	Petrofac, Sharjah
Mazen Marmari	Construction	Petrofac, Sharjah
Faisal Mahmoud	Telecom	Petrofac, Sharjah
K.Nagendra Prasad	Instrumentation	Petrofac, Sharjah
Dayananda Naik	Piping	Petrofac, Sharjah
T.Thamgarajam	Civil	Petrofac, Sharjah
B.Krishnan	Project	Petrofac, Sharjah
M.Suresh	Electrical	Petrofac, Sharjah
Manish Shah	Process	Petrofac, Sharjah
Sanjay Gupta	Project	Petrofac, Sharjah
Jayanarayanam	Static	Petrofac, Sharjah

Following participants were present partly during the study.

Name	Discipline	Company
Jayabal Palanivel	Static	Petrofac, Sharjah
G.Sathyanarayanan	Project	Petrofac, Sharjah
Agit Zende	Project	Petrofac, Sharjah
M.N.Ravi	Civil	Petrofac, Sharjah

3.0 HAZID METHODOLOGY

3.1 HAZID Approach

The HAZID technique is a team review of the proposed facility design that systematically reviews the process configuration and layout to identify credible major hazards. The study was carried out as per PIL Engineering Design Guide - HAZID Methodology, PEC-BMS-EN-GDE-S-0753. A series of guide words and generic listing of hazards (Appendix 1) provide a focus for the brainstorming sessions.

The following steps outline the HAZID approach, and are illustrated in Figure 3.1:

Step 1 - Design Description

The applicable Project/Discipline engineer/s describes to the team details of the design, its intent and objective.

Step 2 - Hazard Identification

The Chairman using the standard HAZID guide words as a basis, (see Appendix I), establishes with the team a list of major hazards associated with the design under review. This listing is generic: the Chairman may use additional guidewords or checklists for critical areas, or if more detail is required.

Step 3 -Credibility of Risk

Each scenario is reviewed to determine whether it is credible for the hazard to be realised.

Step 4 - Consequence Assessment and Risk Management

Each hazard carried forward from Step 2 shall be evaluated by the team to determine:

- The potential causes - identify as many causes as possible.
- The consequence arising from each cause, and potential escalation.
- Identify the measures in place (design/procedure) to prevent, mitigate and/or control the hazard. For each cause identify as many measures as possible which are independent of each other. Reference where these measures are specified, e.g. design basis, philosophy, functional specification, operating procedure.
- Where no measures exist, identify potential measures to prevent, mitigate and/or control the hazard. However, do not waste time on this activity: if a quick solution cannot be found, raise a general action.

Step 5 - Record on Worksheet & Action Tracking

Complete the worksheet, with recommendations for actions. Prepare report and issue for review /action in accordance with project requirements.

All hazards raised in the HAZID will be maintained in a tracking register until satisfactorily closed out.

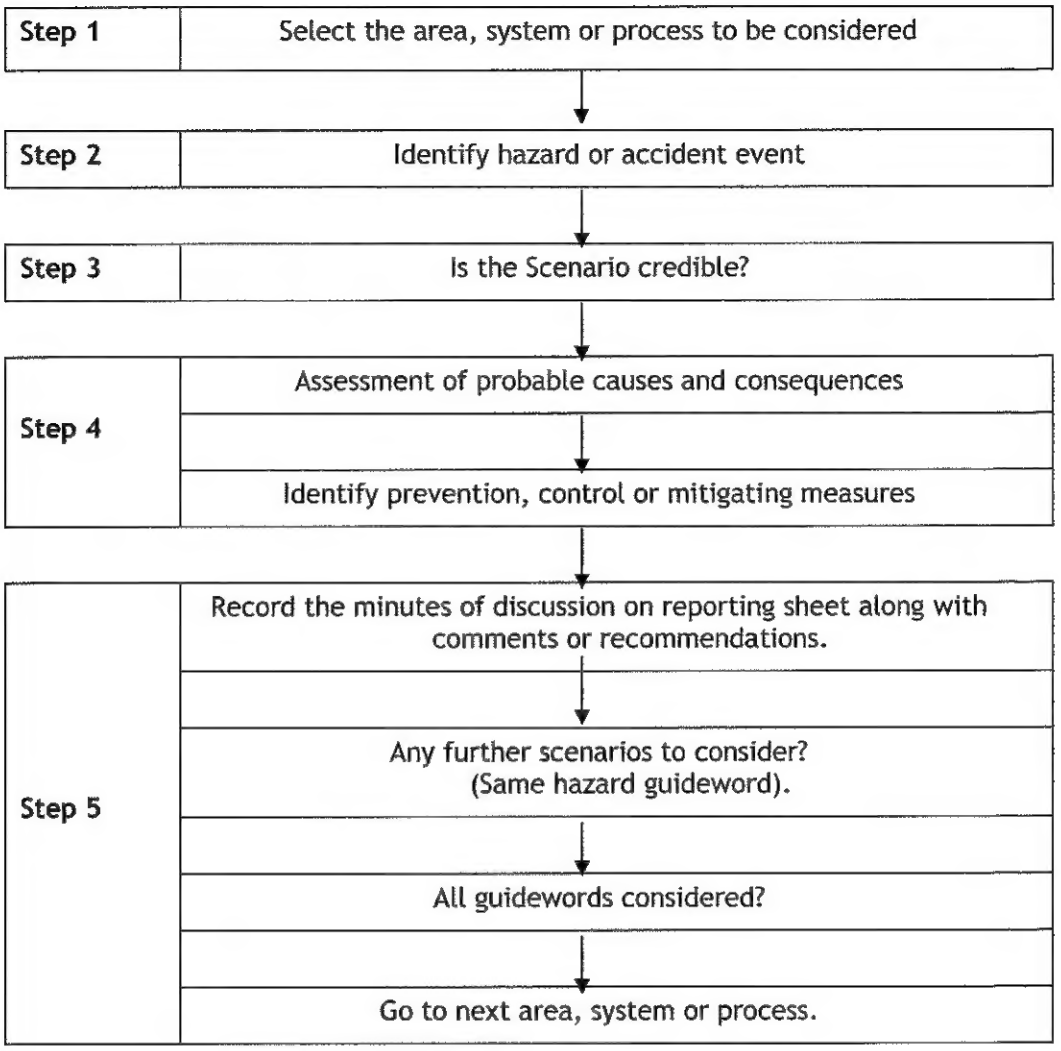

Figure 3.1: Flowchart for Hazard Identification Technique

4.0 HAZID FINDINGS

In general the design was found to be in accordance with project philosophy and good engineering practices. The recommendations made by review team during the HAZID workshop were recorded in the worksheets and should be considered by the relevant group during detail design phase and implemented if they represent a viable risk reduction or alternates be considered.

A summary of the Actions items from the HAZID workshop are given below:

Action Items.	ACTIONS / REMARKS	ACTION BY
1.	Air inlet filters to be cleaned as per appropriate operating and maintenance procedures for extreme climatic like sand storm	KPC
2.	Optical F&G devices to be cleaned.	KPC
3.	KPC to review mitigating measures for the potential damage to the facility / personnel from man made hazard	KPC
4.	KPC to confirm that construction/camp areas are clear of mines.	KPC
5.	Evaluate risk from flare radiation and dispersion as per project flare design philosophy.	HSE
6.	Identify sterile area and plant fence.	HSE
7.	Company to confirm the new site area is free of underground services	KPC
8.	Project to review journey distance between accommodation and site.	Project
9.	Access to site to be reviewed during construction	Construction
10.	Develop health management plan.	HSE
11.	Maintenance Access will be reviewed by 3D model review.	Project/ Piping
12.	Area classification design to be performed as per project specification.	HSE
13.	Establish a design basis for consequence modeling	HSE
14.	3D model to review fire fighting equipment access and escape route	Piping/HSE
15.	Overall emergency and evacuation and rescue plan a to be developed by KPC.	KPC

Action Items.	ACTIONS / REMARKS	ACTION BY
16.	Carry out HAZOP and SIL study.	Project
17.	Hydrate formation report to be developed for low temp. condition like winter,...etc.	Process
18.	Company to keep monitoring of the feed composition for process hazards	KPC
19.	HAZOP to be performed for process hazards	project
20.	3D model to be reviewed for checking the operation and maintenance adequacy.	Project
21.	Human factor engineering during 3D model design review.	Piping
22.	Operation / maintenance / control philosophy to be developed.	Process
23.	Company to provide manning philosophy for impact on control/operating philosophy.	KPC
24.	Method statement to be developed to manage each tie- in.	Construction
25.	HAZCON to be performed to address construction hazards due to tie-ins.	Construction
26.	HAZCON to address radiation concerns during NDT.	Construction
27.	HAZCON to be performed to address all construction hazards.	Construction
28.	HAZCON to be performed for further hazards	Construction
29.	Emergency and evacuation plan to be developed.	Construction (HSE)
30.	Company to manage permit to work issues and interfaces for working inside existing plant area.	KPC
31.	HAZCON to address escape concerns	Construction
32.	Company to develop overall evacuation and rescue procedures and identify muster point location.	KPC
33.	Review emergency lighting requirements for escape routes as per electrical design basis.	Electrical
34.	HAZCON to address vessel entry, working in confined spaces during construction	Construction

Action Items.	ACTIONS / REMARKS	ACTION BY
35.	Ensure MSDS requirements are adhered.	HSE/Construc-tion.
36.	Verify access, platforms during 3D model review.	Piping
37.	Company to have EIA in place to take care of environmental issues	KPC
38.	Noise mapping study to be performed.	HSE
39.	Review provision of spill curb beneath diesel day tank	Piping
40.	Review the requirements of fire trap near API separator for open drain system.	Process

Total 40 actions were identified, out of which 29 actions are to be addressed by petrofac and 11 actions are to be achieved for Company to take necessary actions.

All hazards raised in the HAZID will be maintained in a tracking register until satisfactorily closed out.

APPENDIX - 1: SAFETY HAZARD IDENTIFICATION CHECKLIST

The following guide words were applied as appropriate together:

1. **Natural Events** - e.g.: Climate extremes, Earthquakes, Lightning, Subsidence, Geo-hazards, and Volcanoes.
2. **Man Made Hazards** - e.g.: Internal/external security breakdown, Terrorist activities, Acts of War.
3. **Effects on the Surroundings**, e.g.: Location, Layout, Pipeline routing, existing pipelines.
4. **Infrastructure**-e.g.: Supply and export support, Transportation, Accommodation
5. **Typical Layout Hazards** - Orientation with respect to prevailing winds, Segregation of process hazards from personnel, Vulnerability (fire, smoke, missiles, blast, vehicle impacts), Effects of flare radiation, Evaporation Pond/Burn Pit Location, Access for maintenance, Access for Tanker, Hot surfaces and ignition sources, Future expansion.
6. **Fire and Explosion Hazards** - Reservoir hydrocarbons, Shallow gas, Wellheads, Pipelines and flow lines, Process hydrocarbon inventories (isolatable between ESDV's), Release of inventory (corrosion/erosion, mechanical failure, control failure). Stored flammables (improper storage, operator error, separation, alternative products). Sources of ignition, Fire protection and response (active and passive), Fire and gas detection and shutdowns, Means of escape, Personnel protection.
7. **Utility and Non Process System Hazards** - Effects of flare radiation, HVAC (inlets / exhausts), TEG, Hot Oil, Diesel.
8. **Control/Operations** - e.g.: Manning levels and Operations/Maintenance/Control philosophies, Access requirements, Equipment commonality, Heavy lifts, Transport (road or air), SIMOPS (drilling, work-over, completion, maintenance), Emergency response, Start up and shutdown.
9. **Construction Hazards** - e.g.: Tie-ins (shutdown and isolation requirements), Simultaneous operations, Interface to shutdown, ESD, Equipment handling, Level of prefabrication (limits to construction personnel exposure).
10. **Health Hazards** - e.g.: Asphyxiation (confined space working, vessel entry, smoke, exhausts), Hazards from chemicals, Toxic hazards from chemicals and hazardous atmospheres, Physical (noise, radiation, poisonous substances etc), Working Environment (extended working hours), Working hazards (heights, hazardous equipment, hazardous surfaces, electricity)
11. **Contingency Planning** - e.g. means of escape, emergency procedures and control function.
12. **Environmental** - e.g. emissions to air, pollution, water contamination, land pollution, disposal of waste, use of energy, use of other natural resources, noise.

(Reference: Engineering Design Guide - HAZID Methodology; PI-STD-EHS-DG-002)

APPENDIX - 2: HAZID WORKSHEETS

Sl. No.	HAZARD	CAUSES	CONSEQUENCES	MITIGATION METHODS / SAFEGUARDS	ACTIONS / REMARKS	ACTION BY
1.	Climate Extreme - Heat	Solar heat	Effect on personnel & equipment Heat stress Equipment over heating	Equipment design as per environmental conditions defined in design basis. Drinking water, first aid, facilities, PPE and KPC operating procedure, training.		
2.	Climate Extreme	Wind	Effect on structures & equipment	Structures and equipment are designed as per project philosophies and design basis including wind load.		
3.	Climate Extreme	Sand Blowing	Sand storm is a frequent event, sand blowing may cause blockage of desalter heater blower air inlet filters etc. and consequently process shut down. Impact on personnel, structures and equipments.	Field Instrument and electrical equipment will be designed as per applicable IP protection to mitigate effect of sand, or any dust effect. PPE are provided. KPC procedures.	1- Air inlet filters to be cleaned as per appropriate operating and maintenance procedures for extreme climatic like sand storm 2- Optical F&G devices to be cleaned.	KPC KPC
4.	Climate Extreme - Flooding	Rains	Potential flooding of the dyke during occasional raining.	Plant grading philosophy Water is allowed to Percolate to ground.		
5.	Climate Extreme-Subsidence	Rains	Potential subsidence under heavy rain	Rocky ground No subsidence envisaged.		

Sl. No.	HAZARD	CAUSES	CONSEQUENCES	MITIGATION METHODS / SAFEGUARDS	ACTIONS / REMARKS	ACTION BY
6.	Natural Event	Lightning/ static electricity	Potential damage to the facilities Effect on tall structures like columns and flare stack.	Lightening protection as per project design basis.		
7.	Natural Event	Erosion	No major concern.			
8.	Natural Event	Earthquake	Impact on structures	Building, Equipment and structures are designed as per project design basis Moderate seismic zone.		
9.	Man Made Hazards	Theft	Potential damage to the facility /personnel	Plant fence Round the clock security personnel available.		
10.	Man Made Hazards	Terrorist activities -mines	Potential damage to the facility/personnel	as per item (9.0)above	3- KPC to review mitigating measures for the potential damage to the facility / personnel from man made hazard 4- KPC to confirm that construction areas are clear of land mines.	KPC KPC

Sl. No.	HAZARD	CAUSES	CONSEQUENCES	MITIGATION METHODS / SAFEGUARDS	ACTIONS / REMARKS	ACTION BY
11.	Effects on Surroundings	Hot exhaust from GTG's stacks	Flue gases effect on personnel and HVAC air intake.	HVAC and stack height design as per project design basis.		
12.	Effects on Surrounding	Toxic gas release / heat radiation from flares	Potential exposure to personnel	Flare located downwind of the plant area	5- Evaluate risk from flare radiation and dispersion as per project flare design philosophy. 6- Identify sterile area and plant fence.	HSE HSE
13.	Effects on Surroundings	Social effects	Refer to EIA			
14.	Effects on Surroundings	Environmental effects	Refer to EIA			
15.	Effects on Surroundings	Layout and location - Wind effect	Potential for flammable gas entering process area.	Fired heaters and existing control room are cross wind to process area.		
16.	Effects on Surroundings	Working in the existing plant area.	Ignition sources during construction stage. Risk of damage to under ground services.	Company Permit work system will be followed. Permit will identify existing underground services in the work area.		

Sl. No.	HAZARD	CAUSES	CONSEQUENCES	MITIGATION METHODS / SAFEGUARDS	ACTIONS / REMARKS	ACTION BY
17.	Effects on Surroundings	Redundant under ground line work contains oil	Possible explosion/ environmental / occupational hazard. Underground abandoned lines may collapse due to corrosion.	Company will clear new plant site of all existing underground services.	7- Company to confirm the new site area is free of underground services	KPC
18.	Infrastructure	Transportation - personnel & material	Transportation risk to personnel travelling to and fro site / camp.	Journey management plan will be followed. Material lay down area have been identified adjacent to the job site.	8- Project to review journey distance between accommodation and site.	Project
19.	Infrastructure	Access to site for construction	Potential vehicles movement above the buried pipeline area.	Adequate cross over have been considered over the existing facilities.	9- Access to site to be reviewed during construction	Construction
20.	Infrastructure	Loss of communication within the plant	Loss of communication.	GSM telephones VSAT communication		
21.	Infrastructure	Loss of communication for emergency.	As item (20) above	As item (20) above		
22.	Infrastructure	Medical facilities	Personnel injuries, ill health	First aid facilities at job site Camp clinic with doctor. Availability of ambulance at clinic.	10- Develop health management plan.	HSE

Sl. No.	HAZARD	CAUSES	CONSEQUENCES	MITIGATION METHODS / SAFEGUARDS	ACTIONS / REMARKS	ACTION BY
23.	Typical Layout Hazards	Segregation of process hazards from normally manned areas and ignition sources e.g. control room	Impact on personnel	Control room is cross wind of process area. Fired heaters located cross wind of process area.		
24.	Typical Layout Hazards	Orientation with respect to prevailing wind	Potential exposure to flammable gas clouds. Ignition sources Flare radiation	Flare is far away and down wind of plant area. Fired heaters are cross wind of plant area. GTG's located up wind to plant area. Condensate storage tanks are located down wind plant area.		
25.	Typical Layout Hazards	Segregation of process areas - Segregation from existing process facilities like process units, storage and flare.	Impact on the equipment. Fire escalation	Equipment spacing (for new and existing facilities) as per project HSE philosophy and applicable codes. Active and passive fire fighting system F&G detection system ESD and Blow down protection		

Sl. No.	HAZARD	CAUSES	CONSEQUENCES	MITIGATION METHODS / SAFEGUARDS	ACTIONS / REMARKS	ACTION BY
26.	Typical Layout Hazards	Vulnerability - fire	Potential damage to equipment Fire escalation	As point (25) above.		
27.	Typical Layout Hazards	Vulnerability - smoke	Impact on personnel within buildings.	Smoke detection system provided within the buildings		
28.	Typical Layout Hazards	Vulnerability - Missiles	Impact on equipment	High pressure vessels are designed to applicable codes. PSV, ESD, EV,BD are provided to prevent overpressure.		
29.	Typical Layout Hazards	Vulnerability - Vehicle Impacts	Potential for equipment damage and consequential hazard arising from impacts during maintenance work etc.	Permit to work system will be in place. Adequate access is provided to allow safe vehicles access and maintainability.	11- Maintenance Access will be reviewed during 3D model review.	Project /Piping
30.	Typical Layout Hazards	Effects of flare radiation	No Major Concern	New flare height and location is designed so as to keep radiation levels within allowable limits.		
31.	Typical Layout Hazards	Access for maintenance	Maintenance access is restricted	Same as (29) above.		

Sl. No.	HAZARD	CAUSES	CONSEQUENCES	MITIGATION METHODS / SAFEGUARDS	ACTIONS / REMARKS	ACTION BY
32.	Typical Layout Hazards	Hot surfaces and ignition sources	Burn injuries to personnel Potential release and fire of released inventories.	Insulation and winterisation philosophy as per project sepc. PPE and training procedures. Electrical and instrument to be selected base on hazardous area classification. Fired heaters are located cross wind plant area. Fire and gas, isolation, blow down ESD, and fire fighting facilities.	12- Area classification design to be performed as per project specification	HSE
33.	Typical Layout Hazards	Access for tankers, chemical loading and unloading	Potential chemical spill	Road access adequate for diesel tanker		
34.	Typical Layout Hazards	Fire fighting vehicle access	No major concern	Adequate road access provided from at least two directions.		

Sl. No.	HAZARD	CAUSES	CONSEQUENCES	MITIGATION METHODS / SAFEGUARDS	ACTIONS / REMARKS	ACTION BY
35.	Fire & Explosion Hazards	Stored flammables	Hydrocarbon processing at high pressure leading to potential leaks and fire. Atmospheric storage of hydrocarbons	Fire and Gas detection system. ESD / blow down system will depressurise the system to flare. Fire fighting system Secondary containment (dike).		
36.	Fire & Explosion Hazards	Source of ignition	Flare /fired heaters/GTG's /electrical equipment and static charge leading to fire/explosion of released inventory	Area classification to define electrical / instrument /equipment to minimise ignition sources. Adequate earthing of equipment and above-ground piping to discharge static charges. Use of flame arrestor at tanks vent. Fired heaters are located at cross wind. Flares are located at safe location. GTG's located upwind of the plant.		

Sl. No.	HAZARD	CAUSES	CONSEQUENCES	MITIGATION METHODS / SAFEGUARDS	ACTIONS / REMARKS	ACTION BY
37.	Fire & Explosion Hazards	Equipment layout Inadequate spacing Incorrect equipment sitting congestion	Fire escalation Explosion overpressure	Equipment spacing as per company specification and applicable international codes/standards. Fire and gas detection system. ESD / blow down system will depressurise the containment to flare. Fire fighting system Fire proofing for structure and supports as applicable.	13- Establish a design basis for consequence modelling	HSE
38.	Fire & Explosion Hazards	Fire protection and response	Potential for leading personnel into fire or flammable cloud	Fire fighting system. PPE / training and procedures. Adequate access and escape route. Safety signs and wind socks.	14- 3D model to review fire fighting equipment access and escape route 15- Overall emergency and evacuation and rescue plan to be developed by KPC for fire and explosion hazards.	HSE/ Piping KPC

Sl. No.	HAZARD	CAUSES	CONSEQUENCES	MITIGATION METHODS / SAFEGUARDS	ACTIONS / REMARKS	ACTION BY
39.	Fire & Explosion Hazards	Operator protection	Escape route impairment	Two diverse escape routes are available. Open plant configuration provides multiple escape paths. Safety signs / PPE.		
40.	Fire & Explosion Hazards	Operator protection	External fire	As (39) above. Fire and gas alarms		
41.	Fire & Explosion Hazards	Operator protection	Internal fire Control room / substation impairment	Smoke detection system. Fixed clean agent extinguishing system for auxiliary rack room. Potable extinguishers. HVAC shutdown on gas detection.		

Sl. No.	HAZARD	CAUSES	CONSEQUENCES	MITIGATION METHODS / SAFEGUARDS	ACTIONS / REMARKS	ACTION BY
42.	Process hazards	Release of inventory	Flammable gas cloud leading to explosion and Pool fire	Proper material selection and corrosion allowance. Stress analysis criteria and piping design basis are in place to take care of stress, support and vibration related issues. Fire and gas detection. Isolation / ESD/ Blow Down and depressurising system.		
43.	Process hazards	overpressure	Equipment failure	Safely relief valves High pressure trips.	16- Carry out HAZOP and SIL study.	Project
44.	Process hazards	Over/under temp.	Low temp. During flaring potential for hydrate formation. Winter low temp. Leading to hydrate formation.	Methanol injection. Feed heaters. Flare line material designed for low temp. Conditions for the required sections.	17- Hydrate formation report to be developed for low temp. condition like winter,..etc.	Process

Sl. No.	HAZARD	CAUSES	CONSEQUENCES	MITIGATION METHODS / SAFEGUARDS	ACTIONS / REMARKS	ACTION BY
45.	Process hazards	Wrong composition/phase	Feed gas composition changes Process malfunction		18- Company to keep monitoring of the feed composition for process hazards. 19- HAZOP to be performed for process hazards.	KPC Project
46.	Control / operations	Access requirements	Restricted access	Permit to work system adequate access for operation and maintenance	20- 3D model to be reviewed for checking the operation and maintenance adequacy. 21- Human factor engineering during 3D model review.	Project Project
47.	Control / operations	Operation / maintenance / control philosophy	Equipment Failure. Potential impact on production.	Operation / maintenance / control philosophy	22- Operation / maintenance / control philosophy to be developed.	Process
48.	Control / operations	Manning philosophy	Impact on control/operating philosophy		23- Company to provide manning philosophy for impact on control/operating philosophy.	KPC

Sl. No.	HAZARD	CAUSES	CONSEQUENCES	MITIGATION METHODS / SAFEGUARDS	ACTIONS / REMARKS	ACTION BY
49.	Construction hazards	Tie ins	Potential loss of containment leading to fire Environmental pollution	Permit to work / planned shutdown	24- Method statement to be developed to manage each tie- in. 25- HAZCON to be performed to address construction hazards due to tie-ins.	Constru -ction Constru -ction
50.	Construction hazards	Radiation during NDT	Radiation exposure impact on health.	Permit to work. To be carried by specialised team with adequate PPE. Barricade work area.	26- HAZCON to address radiation concerns.	Constru -ction
51.	Construction hazards	Open trenches, scaffolding, working at heights, confined area, heavy lifts	Personnel injury/fatality Equipment damage		27- HAZCON to be performed to address all construction hazards.	Constru -ction
52.	Construction hazards	SIMOPS	As item (51) above	Company Permit work system will be followed. Permit will identify existing underground services in the work area. Slit trenching and U/G metal detection to validate U/G services for design team inputs.	28- HAZCON to be performed for further hazards.	Constru -ction

Sl. No.	HAZARD	CAUSES	CONSEQUENCES	MITIGATION METHODS / SAFEGUARDS	ACTIONS / REMARKS	ACTION BY
53.	Construction hazards	Construction near existing facilities	Fire and explosion risk exposure to construction workers.	Emergency and evacuation plan. PPE Fire fighting system at the existing plant. Fire and gas detection alarm at existing plant	29- Emergency and Evacuation Plan to be developed.	Constru -ction (HSE)
54.	Construction Hazards	Possible interface issues because of Company sub-contractors at existing plant.	Possible conflicts in use of permit to work, use of plot space, access etc.	Permit to work.	30- Company to manage permit to work issues and interfaces for working inside existing plant area.	KPC
55.	Escape Facility design	Emergency in the plant - Construction phase	Escape facility impairment		31- HAZCON to address escape concerns	Constru -ction

Sl. No.	HAZARD	CAUSES	CONSEQUENCES	MITIGATION METHODS / SAFEGUARDS	ACTIONS / REMARKS	ACTION BY
56.	Escape Facility design	Emergency in the plant-operation phase	Inability to reach safe location	Refer to item(38) above	32- Company to develop overall evacuation and rescue procedures and identify muster point location. 33- Review emergency lighting requirements for escape routes as per electrical design basis.	KPC Electrical
57.	Health Hazards - Confined Space	Vessel entry Working in confined space	Personnel injury	Operating and maintenance procedures. Permit to work system.	34- HAZCON to address during construction	Constru -ction
58.	Health Hazards -	Chemical handling	Personnel injury	Eye wash and Safety shower. PPE. Safety signs. Training and procedures.	35- Ensure MSDS requirements are adhered.	HSE / Constru -ction.

Sl. No.	HAZARD	CAUSES	CONSEQUENCES	MITIGATION METHODS / SAFEGUARDS	ACTIONS / REMARKS	ACTION BY
59.	Health Hazards - Working hazard	Working at height	Fall from height Personnel injury	Permit to work Scaf tags. PPE. Design features include access platforms with handrails, toe guards, access ladders as required.	36- Verify access, platforms during 3D model review.	Piping
60.	Environmental	Continuous plant discharge to air	Impact on flora and fauna	Refer to EIA. Smokeless flaring during normal operation. High efficiency burners meeting local regulations.	37- Company to have EIA in place to take care of environmental issues.	KPC
61.	Environmental	Waste disposal options	Impact from mercury adsorbent Treated produced water to evaporation pond	Company waste disposal procedures.		
62.	Environmental	Noise	Noise pollution Hearing impairment	PPE Safety signs. Noise limitation as per HSE Design philosophy.	38- Noise mapping study to be performed.	HSE
63.	Environmental	Construction waste	Scrap material Garbage (solid and liquid waste) sewage	Disposal of waste at company designated area		

Sl. No.	HAZARD	CAUSES	CONSEQUENCES	MITIGATION METHODS / SAFEGUARDS	ACTIONS / REMARKS	ACTION BY
64.	Environmental	Emergency/upsets discharges	Impact from emergency flaring, venting. Evaporation Pond lined.	Flare design to meet project design basis.		
65.	Environmental	Continuous plant discharge to land	No Major concern	Lined evaporation Pond to contain treated produced water		
66.	Utility system	Fire water	Low low level in fire water tank leading to operation shut down	Spare fire water pump. Ring main network ensuring supply of water from two different directions. Tie-in from existing network. Six hours fire water storage capacity.		
67.	Utility system	Fuel gas	No major concern	Back up from export gas grid and slug catcher.		
68.	Utility system	Heating medium	Failure leading to process shut down	Three working and one hot oil heater stand by configuration. Spare hot oil pump.		
69.	Utility system	Diesel fuel	Spill during transfer - loading		39- Review provision of spill curb beneath diesel day tank	Piping

Sl. No.	HAZARD	CAUSES	CONSEQUENCES	MITIGATION METHODS / SAFEGUARDS	ACTIONS / REMARKS	ACTION BY
70.	Utility system	Power supply	Failure leading to process shut down	Emergency DG sets and UPS available for critical services and safe shutdown.		
71.	Utility system	drains	No major concern		40- Review the requirements of fire trap near API separator for open drain system.	Process
72.	Utility system	Inert gas	No major concern	Stand by nitrogen generator One Air compressor on Emergency DG.		
73.	Utility system	Waste storage and treatment	Environmental damage	Oil from OW separator pumped back to condensate storage tank. Refer to environmental hazards		
74.	Utility system	Chemical/fuel storage	Spills Personnel injury	Refer to health and environmental hazards.		
75.	Utility system	Potable water	Contamination Water quality	Potable water supply from existing facilities. Lines routed A/G to avoid contamination.		
76.	Utility system	sewage	Health issues Environmental Impact	Refer to EIA.		

Sl. No.	HAZARD	CAUSES	CONSEQUENCES	MITIGATION METHODS / SAFEGUARDS	ACTIONS / REMARKS	ACTION BY
77.	Utility system	Instrument air.	Failure leading to process shut down	Spare air compressor. Instrument air receivers capacity sufficient for safe shutdown of the plant. Instrument air bottles provided for double acting ESD valves and depressurising valves. Fail safe position for ESD, BDV, control valves.		